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A Comparison of Home Range Estimates for a Bald Eagle Wintering in New Mexico

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Although Bald Eagles (*Haliaeetus leucocephalus*) have been extensively studied throughout their winter range during the past three decades, little information on wintering home range size has been published. Mean winter (January to March) home range of 12 radio-tagged adult bald eagles in southcentral Colorado was 311 km^2 (Harmata 1984). Grubb et al. (1989) reported a mean seasonal (February to March) home range of 401 km^2 for four immature Bald Eagles in northcentral Arizona based on inter-roost movements. Home range of four immatures in Missouri in 1976 averaged 48 km^2 and those of six adults and four immatures in 1978 averaged 18 km^2 (Griffin and Baskett 1985). McClelland et al. (in prep.) reported home ranges of 471 to 4000 km^2 for four adults and 102 to 386 km^2 for three immatures wintering separately in Montana, Utah, and California-Oregon. In all four studies minimum convex polygons were drawn that contained all radio-telemetry points but excluded non-use areas.

Using computer simulated data for which the actual home range was known, Boulanger and White (1990) showed that five commonly used home range estimators behaved with significantly different bias and precision. No one has documented the effect that a habitat that is not randomly or uniformly present in an animal's potential home range, such as rivers or lakes, has on these estimators. Wintering Bald Eagles generally concentrate in aquatic habitats (Steenhof 1978) and, if food is sufficient, utilize them to the exclusion of other nearby habitats (Stalmaster 1987).

Study Area and Methods

Abiquiu Reservoir is on the Rio Chama in north-central New Mexico (Fig. 1A). The authorized storage pool is 1896 m, at which level the surface area is 1675 ha. The reservoir is surrounded by extensive pinyon (*Pinus edulis*)-juniper (*Juniperus* sp.) savannah. Dead Cottonwoods (*Populus angustifolia*) are present in two bays while live cottonwoods line the Rio Chama. Winter temperatures are generally moderate, but in mid-February 1988 open water on the reservoir was restricted to two pools of 5 and 15 ha. Open water gradually increased in area until by mid-March the entire reservoir was ice-free. The Rio Chama remained >75% ice-free during the same period.

An adult male Bald Eagle was captured at Abiquiu Reservoir, New Mexico, on 13 February 1988 in a padded leghold trap (Harmata 1985) buried in a shoreline knoll. He was measured, radiotagged and released within 4 hr, 4 km across the lake from the point of capture. Gender was later confirmed by his copulatory position with an adult female who wintered in close association. We monitored his movements and behavior, often from dawn to dusk, on 29 of the 38 d he remained in the study area. During that period he was perched 191 hr; we had visual contact during 184 hr (96%). We utilized this extensive data set to characterize his wintering habits and to compare home ranges produced by five estimators.

Results and Discussion

The eagle was captured at the 15 ha pool; he continued to forage over the lake after release. Of 30 prey captures or foraging attempts observed, 22 (73%) were fish, 4 (13%) were waterfowl, and 4 (13%) were not identified. His primary night roost was in a flood-killed cottonwood (Fig. 1A). He roosted there 31 of the 38 (82%) nights he remained in the study area after capture. He returned to this reservoir roost even when he foraged along the Rio Chama in March. His secondary roost, on the west slope in a narrow canyon on the upper lake (Fig. 1A), was used primarily after days with strong southwest winds or after human activity (i.e., boats) near his primary roost.

A perching location was used for home range analysis if the eagle remained there for more than 30 min. Though true statistical independence (Swihart and Slade 1985) was probably not obtained, we assumed biological independence because this time period would have allowed the eagle to move throughout his home range (Lair 1987, Ganey and Balda 1989). Harmonic mean, Jennrich-Turner non-circular ellipse, weighted non-circular ellipse, and minimum convex polygon home ranges were calculated by the computer program HOME RANGE (Samuel et al. 1985), based on the assumptions and restrictions described by Samuel and Garton (1985). Home range size was also calculated for a minimum convex polygon drawn to ex-

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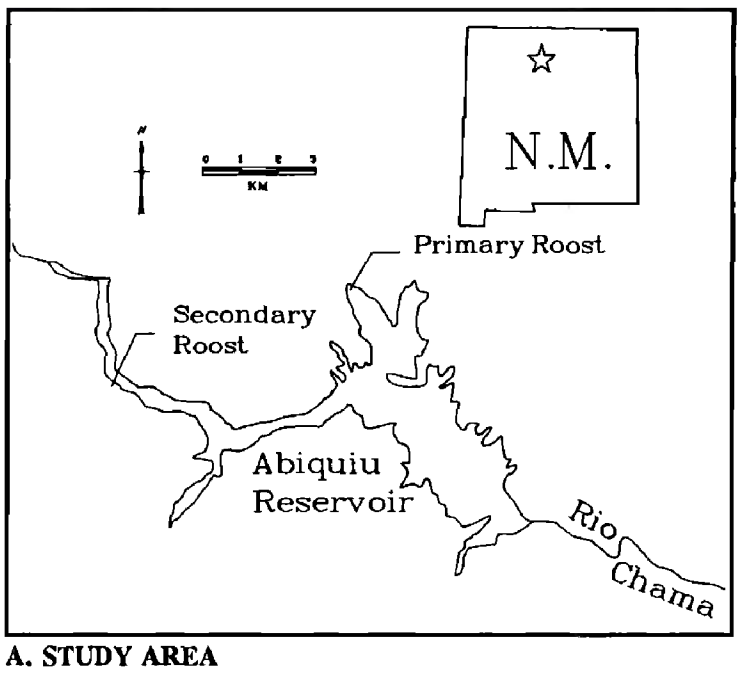
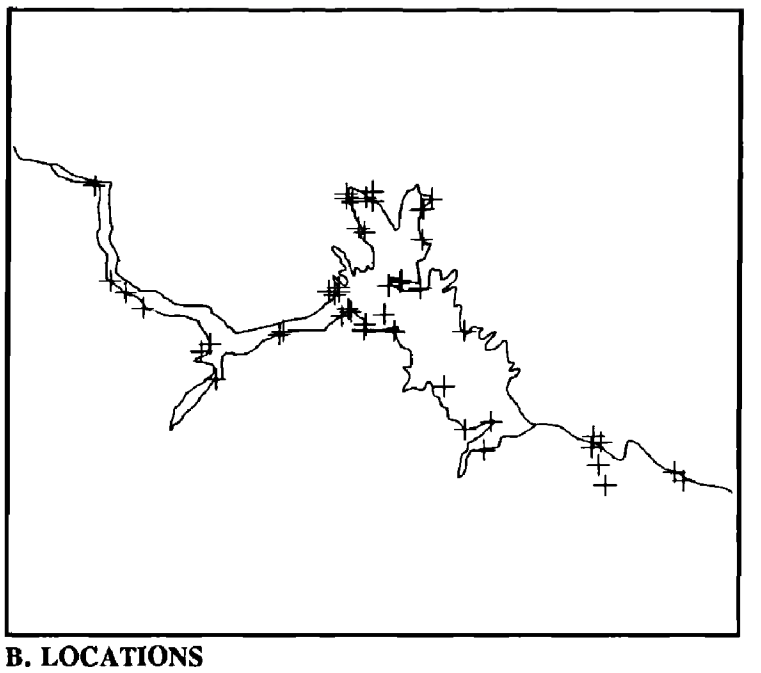
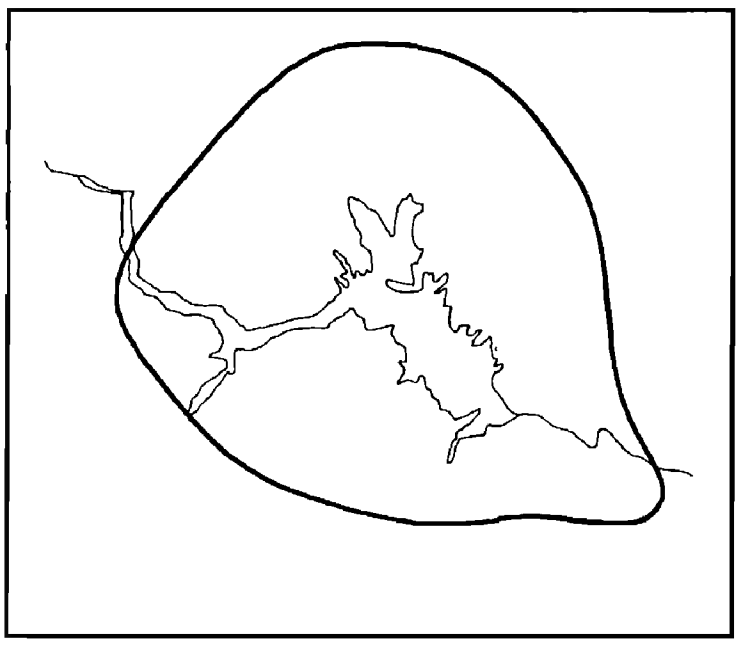


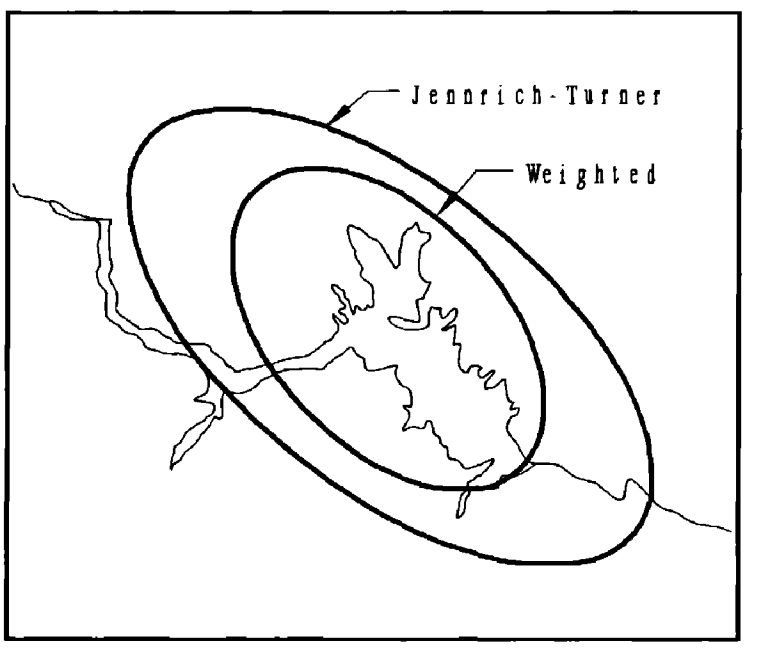
A. STUDY AREA



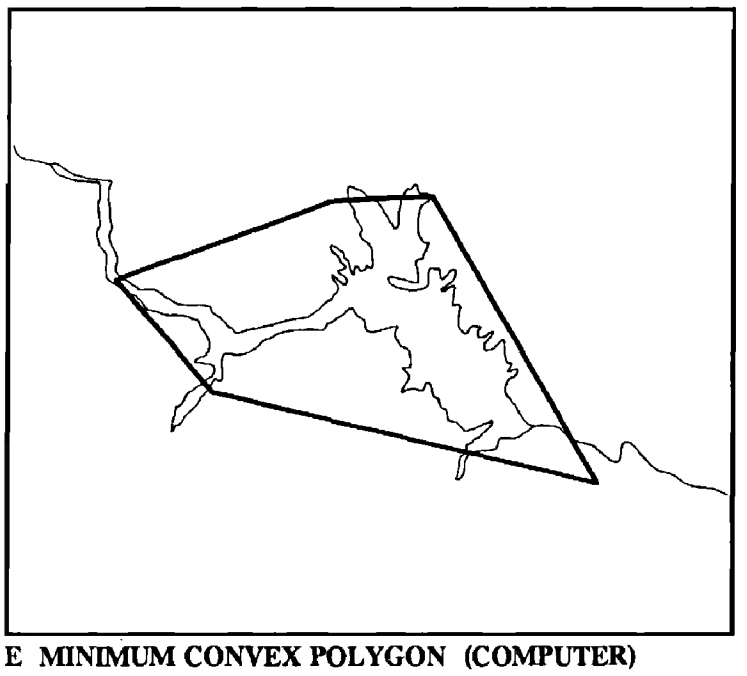
B. LOCATIONS



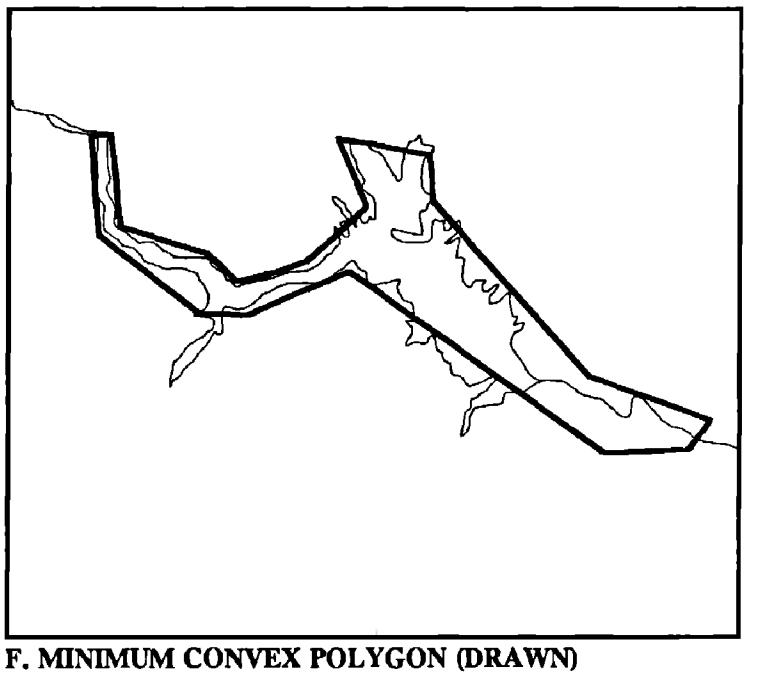
C. HARMONIC MEAN



D. NON-CIRCULAR



E MINIMUM CONVEX POLYGON (COMPUTER)



F. MINIMUM CONVEX POLYGON (DRAWN)

Figure 1. Study area, telemetry locations, and five estimates of home range for an adult Bald Eagle, Abiquiu Reservoir, New Mexico, February to March 1988. Computer generated estimates are at the 95% confidence level while the drawn minimum convex polygon incorporates 100% of radio-locations.

clude non-use areas (Harmata 1984, Griffin and Baskett 1985, Grubb et al. 1989).

All 271 documented perch locations were on 45 perch trees and all 45 perches (Fig. 1B) were used at least once for more than 30 min. Estimates of the eagle's home range (km^2) based on 126 perch uses >30 min were: harmonic mean = 170.0 (Fig. 1C), Jennrich-Turner non-circular ellipse = 105.0 (Fig. 1D), weighted non-circular ellipse = 58.3 (Fig. 1D), minimum convex polygon (computer) = 57.6 (Fig. 1E), and minimum convex polygon (drawn) = 16.1 (Fig. 1F).

All four computer generated estimates of the eagle's home range included considerable areas of upland habitat that the eagle never used (Fig. 1). All of his perches were adjacent to or overlooking Abiquiu Reservoir or the Rio Chama. Further, all direct flights we observed were over the reservoir or along the river, and most soaring flights were probably over or near the reservoir. Therefore the minimum convex polygon drawn to include only the aquatic habitat used by the eagle provided the best estimate of his winter home range (Fig. 1F).

The home range estimates generated by computer were larger because there was no means of recognizing unused upland areas as different from the aquatic areas the eagle used and deleting them. Unless a program is developed that can include habitat availability and species preferences, these programmed estimators will not be suitable for situations where habitats are not homogenous or random.

The 16 km^2 winter home range in New Mexico is among the smallest reported for Bald Eagles; only in Missouri, where ten eagles had a home range mean of 18 km^2 in 1978 (Griffin and Baskett 1985) were comparable or smaller home ranges reported. In Missouri the radio-tagged Bald Eagles were among 100 eagles that fed primarily on carcasses where 180 000 Canada Geese (*Branta canadensis*) were concentrated. Though they centered their activities at aquatic habitats, Arizona (Grubb et al. 1989) and Colorado (Harmata 1984) radio-tagged Bald Eagles foraged more widely for mammalian carrion when these feeding areas were frozen. The Abiquiu Reservoir eagle, who fed primarily on fish, was able to meet his nutritional needs in a small winter range that did not attract nor could not have supported a large number of eagles. It is noteworthy, then, as an example of a different foraging/wintering strategy than those previously published.

RESUMEN.—Un Águila Cabeciblanca macho (*Haliaeetus leucocephalus*) que invernaba cerca del Reservorio Abiquiu en Nuevo México, y que fue capturado el 13 de febrero de 1988, fue rediocontrolado por 191 horas durante 29 de los 38 días en que permanenció en al área de estudio. Esta ave usó 45 perchas diferentes (Fig. 1B). Cada una de las 126 paradas que hizo en esas perchas, duró más del mínimo de la "independencia biológica" que es 30 min. Las estimaciones de la extensión del territorio habitado (en km^2), generadas por computadora, fueron: media armónica = 170.0 (Fig. 1C); elipse no circular Jennrich-Turner = 105.0 (Fig. 1D); elipse no circular concentrada = 58.3 (Fig. 1D); y polígono convexo mínimo = 57.6 (Fig. 1E). Un polígono convexo mínimo trazado para excluir áreas no usables ofreció el mejor estimado de la extensión del territorio invernal de esta ave raptora (16.1 km^2, Fig. 1F).

Alimentándose básicamente con peces, debido a que las aguas no se congelaron, esta águila fue capaz de satisfacer sus necesidades de nutrición en un territorio de habitación pequeño. Éste fue menos extenso que los territorios que dan la mayoría de previos estudios publicados.

[Traducción de Eudoxio Paredes-Ruiz]

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LITERATURE CITED

BOULANGER, J.G. AND G.C. WHITE. 1990. A comparison of home range estimators using Monte Carlo simulation. *J. Wildl. Manage.* 54:310–315.

GANEY, J.L. AND R.P. BALDA. 1989. Home-range characteristics of spotted owls in Arizona. *J. Wildl. Manage.* 53:1159–1165.

GRIFFIN, C.R. AND R.S. BASKETT. 1985. Food availability and winter range sizes of immature and adult Bald Eagles. *J. Wildl. Manage.* 49:592–594.

GRUBB, T.G., S.J. NAGILLER, W.L. EAKLE AND G.A. GOODWIN. 1989. Winter roosting patterns of Bald Eagles (*Haliaeetus leucocephalus*) in north-central Arizona. *Southwest. Nat.* 34:453–459.

HARMATA, A.R. 1984. Bald Eagles of the San Luis Valley, Colorado: their winter ecology and spring migration. Ph.D. thesis. Montana State University, Bozeman, MT U.S.A.

———. 1985. Capture of wintering and nesting Bald Eagles. Pages 139–159 *in* J.M. Gerrard and T.N. Ingrams [EDS.], The Bald Eagle in Canada. Proceedings of Bald Eagle Days, 1983, White Horse Plains Publishers, Headingly, MB Canada.

LAIR, H. 1987. Estimating the location of the focal center in red squirrel home ranges. *Ecology* 68:1092–1101.

MCCLELLAND, B.R., L.S. YOUNG, P.T. MCCLELLAND, J. CRENSHAW, H.L. ALLEN AND D.S. SHEA. In prep. Migration ecology of Bald Eagles from an autumn concentration in Glacier National Park, Montana.

SAMUEL, M.D. AND E.O. GARTON. 1985. Home range: a weighted normal estimate and tests of underlying assumptions. *J. Wildl. Manage.* 49:513–518.

———, D.J. PIERCE, E.O. GARTON, L.J. NELSON AND K.B. DIXON. 1985. User's manual for program

HOME RANGE. Tech. Report No. 15. University of Idaho Forest, Wildlife, and Range Experiment Station, Moscow, ID U.S.A.

STALMASTER, M.V. 1987. The Bald Eagle. Universe Books, New York, NY U.S.A.

STEENHOF, K. 1978. Management of wintering Bald Eagles. Publ. FWS/OBS-78/79. U.S. Fish and Wildlife Service, Department of Interior, Washington, DC U.S.A.

SWIHART, R.K. AND N.A. SLADE. 1985. Testing for independence of observations in animal movements. *Ecology* 66:1176–1184.

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